Accepted Manuscript

Methanol Steam Reforming Performance Optimisation of Cylindrical Microreactor for Hydrogen Production Utilising Error backpropagation and Genetic Algorithm

Tianqing Zheng, Wei Zhou, Wei Yu, Yuzhi Ke, Yangxu Liu, Ruiliang Liu, Kwan San Hui

PII: S1385-8947(18)31846-1
DOI: https://doi.org/10.1016/j.cej.2018.09.129
Reference: CEJ 19968

To appear in: *Chemical Engineering Journal*

Received Date: 28 April 2018
Revised Date: 17 July 2018
Accepted Date: 17 September 2018

Methanol Steam Reforming Performance Optimisation of Cylindrical Microreactor for Hydrogen Production Utilising Error backpropagation and Genetic Algorithm

Tianqing Zheng [1], Wei Zhou [1*], Wei Yu [1], Yuzhi Ke [1], Yangxu Liu [1], Ruiliang Liu [1], Kwan San Hui [2]

[1] *Department of Mechanical & Electrical Engineering, Xiamen University, Xiamen 361005, China*

[2] *School of Mathematics, University of East Anglia, Norwich, NR4 7TJ, United Kingdom*

Abstract: To optimise methanol steam reforming performance of cylindrical microreactor for hydrogen production, an error backpropagation algorithm was used to build a mathematical model for reaction performance of different microreactors for hydrogen production. Additionally, a genetic algorithm (GA) was utilised to process the computational model to obtain the optimum reaction parameters. The reliability of the optimum reaction parameters of cylindrical microreactor for hydrogen production was verified by experiments. Firstly, take plate microreactor as an example, the porosity of porous copper fiber sintered sheet (PCFSS), reaction temperature of methanol steam reforming for hydrogen production, injection velocity of the methanol and water mixture, and catalyst loading of PCFSS were considered as input data, whereas methanol conversion was used as output data. The computational model for specific testing system was gained by utilising input and output data from specific testing system to train the mathematical model for different microreactors, combining with matrix laboratory (MATLAB) neural network toolbox and designed MATLAB program. The E_{max} of 5% for plate microreactor and E_{max} of 3.2% for cylindrical microreactor verified the good predictive ability and reliability of the computational model for plate and cylindrical microreactor, indicating the reliability and universal applicability of the mathematical model for different microreactors. Secondly, the effects and mechanisms of PPI, reaction temperature, injection velocity, and catalyst loading on methanol conversion were studied, relying on the computational model. Finally, the optimum reaction parameters were acquired using GA, MATLAB neural network toolbox and designed MATLAB program. The validity of the optimum reaction parameters of cylindrical microreactor for hydrogen production was confirmed by experiments. This study provides a reference method for methanol steam reforming performance optimisation for hydrogen production.

Keywords: Methanol steam reforming microreactor; Hydrogen production; Error backpropagation algorithm; Genetic algorithm; Methanol conversion

---

*Corresponding author. Tel.: 86-592-2188698; Fax: 86-592-2186383
E-mail address: weizhou@xmu.edu.cn (Wei Zhou).